Climate change adaptation and the Least Developed Countries Fund (LDCF): qualitative insights from policy implementation in the Asia-Pacific

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Climate change adaptation and the Least Developed Countries Fund (LDCF): Qualitative insights from policy implementation in the Asia-Pacific

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Abstract Least developed countries often lack the requisite capacity to implement climate change adaptation projects. The Least Developed Countries Fund (LDCF) is a scheme where industrialized countries have (as of early 2016) disbursed $934.5 million in voluntary contributions, raised more than four times that amount in co-financing, and supported 213 adaptation projects across 51 least developed countries. But what sorts of challenges have arisen during implementation? Based on extensive field research in five least developed countries—Bangladesh, Bhutan, Cambodia, the Maldives, and Vanuatu—and original data collected from almost 150 research interviews, this article qualitatively explores both the benefits and challenges of LDCF projects in the Asia-Pacific. It finds that while LDCF projects do contribute to enhancing multiple types of infrastructural, institutional, and community-based adaptive capacity, they also suffer from uncertainty, a convoluted management structure, and an inability to fully respond

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to climate risks. Based on these findings, the study concludes that adaptation must be pursued as a multidimensional process; and that LDCF activities have tended to promote marginal rather than more radical or systematic transformations.

Keywords Climate change adaptation · Adaptive capacity · Resilience · Vulnerability

1 Introduction

Climate finance remains at the heart of any new agreement to equitably and efficiently address climate change. This fundamental challenge can be divided into three core issues: how to achieve an optimal balance between climate change mitigation and adaptation funding, how adaption finance can be leveraged, and how the institutions allocating finance ought to be designed and operate (Fridahl and Linnér 2016; Fridahl et al. 2014).

In this paper, we look at the insights gleaned from adaptation finance channeled through the Least Developed Countries Fund (LDCF) in five case study countries between 2008 and 2015. Through a large set of interviews with stakeholders directly involved in disbursing or receiving adaptation finance, coupled with insights from a broader literature review, we provide a synthetic qualitative and narrative assessment of our five LDCF projects. We start by offering a short history of the LDCF and summarizing our qualitative methods. The proceeding sections discuss the effects of and challenges facing the implementation of LDCF projects. We lastly surmise that the LDCF brings to light two salient conclusions related to climate policy and adaptation practice in general: adaptation must be viewed a multidimensional process involving multiple actors, technologies, scales, and governance mechanisms; and insufficient funding and a convoluted management structure blunt the full efficacy of the LDCF.

2 Background

Established in 2001, the LDCF was created to help the poorest countries in the world prepare and implement National Adaptation Programs of Action (NAPAs) to reduce the pending impacts of climate change. Currently one of the world's largest funds for climate adaptation, the Fund has so far leveraged almost $1 billion in voluntary contributions to support projects across more than 50 countries (as of early 2016). These projects have been implemented through partner agencies including the World Bank, United Nations Development Program, and United Nations Environment Program. As the Global Environment Facility (GEF 2012), which formally manages the Fund explains, the LDCF was at its start "seminal in climate change adaptation finance" and it was the "first and most comprehensive adaptation-focused program in operation for least developed countries."

The idea for the LDCF arose out of the seventh session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP7), held in Marrakesh, Morocco, in 2001. The Fund became operational in 2002. At that point the GEF was the only entity operating the financial mechanism of the UNFCCC, with its secretariat hosted at the World Bank. The World Bank was also designated as the GEF's trustee. As Table 1 shows, the LDCF was one of at least six major multilateral funds for adaptation projects, and this Table reflects only multilateral efforts rather than the more voluminous number of bilateral initiatives.

Table 1 Funds for adaptation under the United Nations Framework Convention on Climate Change Regime

Fund	Operational period	Created under	Eligible funding	Eligible beneficiaries	Funding sources
GEF Strategic Priority for Adaptation (SPA)	2004–2011	GEF Trust Fund	Incremental cost to achieve global environmental benefits	Developing countries	GEF Replenishment cycles
Special Climate Change Fund (SCCF)	2002–2015	UNFCCC	Additional costs of adaptation measures. Uses a sliding scale	Developing countries and countries with economies in transition	Developed countries' voluntary contributions
Least Developed Countries Fund (LDCF)	2002–2015	UNFCCC	Additional costs of adaptation measures. Uses a sliding scale	Least developed countries	Developed countries' voluntary contributions
Adaptation Fund (AF)	2009–2015	Kyoto protocol	Concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol	Developing countries	Share of proceeds from the Clean Development Mechanism; developed countries' voluntary contributions
Green Climate Fund (GCF)	2011-	UNFCCC	Adopted as a financial mechanism it aims to make ambitious contribution to attaining a balance of mitigation and adaptation goals of the international community	Developing countries	Over time it is expected to become the main multilateral financing mechanism to support climate action in developing countries.
Pilot Programme for Climate Resilience (PPCR)	2013-	World Bank (and other multilateral and regional development banks)	Assists developing countries in integrating climate resilience into development planning	Developing countries	Developed countries' voluntary contributions

Source: Authors' compilation

The LDCF had a governing body which met twice a year. The LDCF supported two key activities: the preparation of National Adaptation Programmes of Action (NAPAs), policy documents identifying urgent and immediate adaptation needs for least developed countries; and the implementation of adaptation projects meeting those needs. NAPAs essentially mapped and supported priority activities for urgent and immediate needs to adapt to climate change as opposed to National Action Plans, which focus on medium to long term actions. All least developed countries that were a Party to the UNFCCC were eligible for the fund—it operated according to the principle of equitable access rather than "first come, first served," though proposals were formally evaluated based on their country of origin, conformity with existing national policies, and institutional support, among other criteria (GEF 2009a).

Since its creation, as of May 2015—the last time formal numbers were released—the LDCF had funded the completion of 51 NAPAs and the implementation of 213 projects and one program across 51 countries, totaling $934.5 million in pledges (of which 99 % were spent) and leveraging $3.79 billion in co-financing (UNFCCC 2014a, b; GEF 2015). Twenty-five industrialized countries had contributed to the LDCF. As Fig. 1 illustrates, these projects focused on meeting urgent and immediate adaptation needs across a variety of sectors including early warning and natural disasters, agriculture, and water resources (UNFCCC 2014b). Most of these projects were implemented in Africa (94 totaling $631.6 million of direct funding, or 68 % of the total) or Asia (40 projects totaling $268.6 million in direct funding). Projects grew in size over time, with the ten more recent projects in 2014 averaging $6.6 million compared with $3.3 million for the first ten. A closer examination of a smaller subsample of 138 projects revealed that were closely aligned with NAPAs (58 % show "high alignment" with the relevant NAPA), and that agriculture, water, and natural resource management were the most listed priority sectors (listed in 96 %, 87 %, and 78 % of NAPAs analyzed, respectively) (UNFCCC 2014b).

Numerous studies have highlighted the LDCF as a key part of global adaptation financing (Bachofen et al. 2015; Biagini et al. 2014a, b; Rahman and Ahmad 2014; Afful-Koomson 2014; Biagini and Miller 2013; Preston et al. 2011; Klein and Möhner 2011; Osman and Downing 2007). However, they did not assess the overall impact or effectiveness of its projects, especially in a qualitative manner. Two other studies have qualitatively examined LDCF pilot projects being implemented in 2010 and 2011 (Sovacool et al. 2012a, b), but assessed their potential mid-stream, rather than after the projects had been completed. No study has yet offered a comparative, independent, updated evaluation of LDCF performance for fully implemented projects. This led us to examine the benefits, challenges, and lessons learned from the a small sample of LDCF projects, focusing on a suite of five being implemented in the Asia-Pacific across Bangladesh, Bhutan, Cambodia, the Maldives, and Vanuatu.

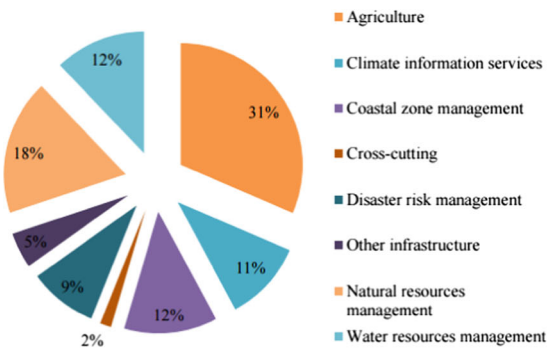
3 Research methods

To analyze policy implementation of the LDCF, we selected a sample of five major efforts summarized by Table 2. These projects cover a breadth of the funded activities: coastal afforestation in Bangladesh, glacial flood control in Bhutan, agricultural production in Cambodia, community relocation in the Maldives, and integrated coastal management in Vanuatu.

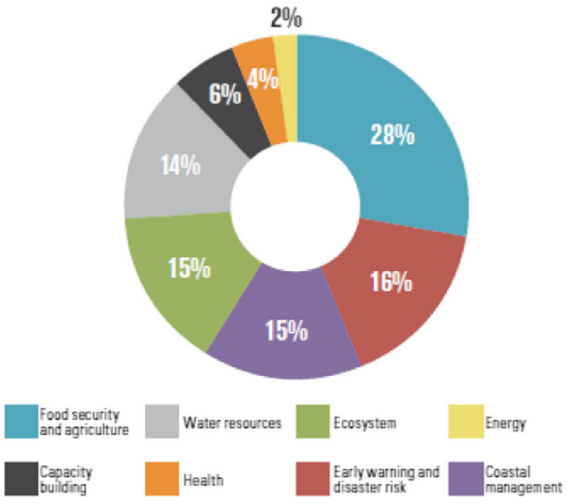
The authors relied on field research and semi-structured expert interviews as our primary tool for data collection on these cases. An interview protocol was designed which included asking participants to (a) identify the most serious climate change related concerns facing

Fig. 1 Development sectors prioritized in NAPAs (as of May 2015)

a *Top panel: LDCF Financing by primary sector*



b *Bottom panel: LCDF financing by NAPA priority*



Source: Compilation of GEF data.

communities in each country, (b) summarize ongoing adaptation efforts related to the LDCF, (c) explicate expected costs and benefits for those efforts, (d) identify obstacles or barriers to implementation, and (e) elaborate on any broader lessons such projects offered the climate policy community.

A semi-structured format was chosen so that respondents could keep their answers relatively open ended. As such, they were free to consider temporal and spatial scales, potential negative and positive long-term impacts of these projects, negative or positive spillover effects, quantitative or qualitative criteria of evaluation, and so on. We did not ground our inquiry or questions into any preconceived theoretical framework so as not to bias the results (Strauss 1990). One benefit to this method is it can produce rich, detailed answers to our questions. Here, we have chosen to present our responses in a more narrative form. This is because, as Hatavara et al. (2013) suggest, narratives are "profoundly relevant to the understanding of life,

Table 2 Summary of five Least Developed Countries Fund (LDCF) projects in the Asia-Pacific

Sector/Type of Adaptation	Country	Budget	Operational period	Primary Actors	Description
Coastal Afforestation	Bangladesh	$10.8 million	March 2009 to February 2013	United Nations Development Program; Forest Department at the Ministry of Environment and Forestry	Utilizes community-based afforestation, mangrove regeneration and plantation management, erosion prevention, and the deployment of coastal sediment barriers to reduce climate-vulnerabilities in four upazilas in the coastal districts of Barguna, Patuakhali, Bhola, Noakhali, and Chittagong
Glacial Flood Control and Early Warning Systems	Bhutan	$8.3 million	March 2008 to February 2013	United Nations Development Program; Department of Geology and Mines at the Ministry of Economic Affairs; Disaster Management Division of the Ministry of Home and Cultural Affairs	Implements a disaster management plan and will demonstrate technologies available to reduce glacial lake outburst floods from the Thorthormi glacial lake in the Punakha-Wandgi Valley and Chamkhar Valleys
Coastal Protection	Maldives	$9 million	March 2010 to February 2013	United Nations Development Program; Ministry of Environment, Energy, and Water	Establishes a climate information system to collect and disseminate knowledge about climate vulnerability and designs a migration plan of Safer Islands where at threat communities can relocate to
Agriculture	Cambodia	$4.4 million	July 2009 to June 2013	United Nations Development Program; Ministry of Agriculture, Fisheries and Forestry; Ministry of Water Resources and Meteorology	Trains engineers in climate-resilient irrigation design (including reservoirs, irrigation canals, ponds, and dykes) and establishes a community-based climate information system on floods and droughts
Sea Level Rise	Vanuatu	$8.8 million	March 2010 to July 2014	United Nations Development Program; Vanuatu's Department of Environmental Protection & Conservation; Ministry of Lands and Natural Resources; Ministry of Climate Change (established 2013)	Promotes community based management of marine resources, creates an integrated coastal management program, and attempts to mainstream climate planning within the government

Source: Authors' compilation based on GEF data

experience, and literary texts." One drawback is that measures of impacts are based on perceptions rather than more independent or objective data, and the narrative form of presentation comes at the expense of a more unified structure (Alber et al. 2013; Czarniawska 2004).

The research team conducted two sets of interviews, those at the start of projects in 2010 followed by those done at least a year after the projects were completed in 2015. The intent was to compare the initial expectations and goals with the results and achievements (or lack thereof). The first batch of interviews, 123 conducted in 2010 (84 % of the sample), were done face-to-face in tandem with field research and site visits, and funded by a grant. In each case we had simultaneous real time translation into local languages and dialects. We relied on a purposive sampling strategy to select participants, meaning experts were chosen to represent different aspects of the cases in question; that is, some were in favor of projects, others were against; some had expertise in engineering or project planning, others in implementation or civil society engagement. We also adhered to an approach that included a broad spectrum of respondents from government, civil society, business, academia, and local communities.

The 2010 interviews were triangulated with a second batch of 23 interviews (16 % of the sample) done via telephone and email in January and February 2015, after each of the projects had closed, and after the funding for our grant had expired. For consistency, the newer interview protocol simply mirrored the questions and approach from the earlier batch. Admittedly, it is disappointing that the second round of the survey is so small (and the panel element even smaller), making it more difficult to compare ex ante expectations with ex post outcomes. The fact that roughly 84 % of respondents were eliciting preferences before projects commenced does bias our results more towards preliminary expectations rather than empirical evaluations. One explanation for this small sample of second batch interviews is that turnover among respondents was high; by our estimate, less than a quarter were still involved with our respective projects at their close when we approached them for follow-up interviews. In spite of these limitations, the large and unique dataset offers rich insights into the expectations and experienced outcomes of LCDF financing and projects. Appendix I provides more details for the full set of 146 interviews; Table 3 offers an overview of the interview data by LDCF project.

At the request of some participants, we present interview data in our article as anonymous with only a respondent number (e.g., "R23" for the 23rd interviewee). A small subsample of our interview pool—9 respondents—were interviewed twice; the rest either declined our invitation for a second interview, had moved onto new positions, or had been replaced by new staff. Interviewees were split almost evenly three ways among (1) those with substantial expert knowledge such as regional planners (working at agencies such as the United Nations or

Table 3 Summary data for research interviews (n = 146)

Case study	2010 interviews	2015 interviews	Total
Bangladesh	15	4	19
Bhutan	20	5	25
Cambodia	30	5	35
Maldives	33	5	38
Vanuatu	14	4	18
Other (i.e., the LDCF fund or GEF in general)	11		11
Total	123	23	146

Source: Authors' compilation

Global Environment Facility), executive managers, directors, senior policymakers; (2) junior experts such as staff and field officers; and (3) community representatives or laypersons. We adhered to an "ethnographic" approach where we took interview responses at face value, neither prompting nor correcting respondents.

We then supplemented our primary interview data with a review of project documents, public reports, and a scattering of peer-reviewed academic articles explicitly mentioned by respondents. As such, our results reflect and are grounded entirely in the data gleaned from the interviews. They therefore do not likely reflect the full state-of-the-art analytical literature on adaptation implementation or the LDCF.

4 Stated effects of LDCF finance

In this section we analyze what LDCF financing has achieved in the five countries according to the qualitative remarks from interviewees (representing government, civil society, business, academia, and local communities). As this section documents, our interview data and literature review suggest that LDCF projects provided three distinct sets of stated effects: (1) strengthening nationally significant infrastructure, (2) enhancing institutional capacity and awareness, and (3) improving community assets.

4.1 Strengthening infrastructure

As intended, each of the five LDCF projects enhanced physical and infrastructural resilience in some way according to more than three-quarters (76 %) of the interviewees. The project in Bangladesh planted 6000 ha of community based mangrove plantations and 500 ha of non-mangrove mount plantations, and erected about 220 km of concrete dykes and more than 1000 km of earthen embankments. As one of our interviewee respondents (R23) put it in 2010, "this part of the project created a 'green shield' around vulnerable communities."

In Bhutan, planners improved early warning systems and drained glacial lakes. The government replaced a manual warning system of human monitoring and the sounding of gongs with an automatic one composed of gauges monitoring glacial lake bathymetry (depth) as well as sensors along rivers connected to automated sirens. As R123 commented in 2015, "now we will know within seconds if a glacial lake outburst flood occurs, rather than before when it could take minutes or even hours to properly warn people."

In Cambodia, retention ponds, canals, dykes, and reservoirs for agriculture have been repaired. Irrigation systems using design parameters derived from historical hydrological patterns have also been upgraded so they can withstand future droughts or floods. There, R130 was confident (in 2015) that the project has "made farming more secure, and climate-proof for Cambodia" and "facilitated improvements in efficiency and output, especially for rice."

In the Maldives, planners bolstered infrastructural adaptation by replenishing natural sea ridges, planting mangroves and vegetation on shorelines, and raising the height of water storage tanks so they are no longer susceptible to sea swells and saltwater intrusion. As R66 noted in 2010:

> *The key to the [the LDCF project] is moving beyond hard infrastructure to soft protection, using ecosystems and trees as measures to improve resilience that are cheaper, environmentally more sound, and longer lasting than their capital- and technology-intensive counterparts.*

In Vanuatu, on Epi Island investments were made to repair roads, bridges, and wharves at risk to sea level rise, and also to erect coastal walls to reduce the severity of storm surges, especially in rural areas, and among coastlines. As R106 stated in 2010:

> *In Vanuatu, about 80% of people reside in rural areas and engage in subsistence, rain-fed agriculture on coastal plains. Thus valuable and arable land is located within the coastal zone. Coastal fisheries contribute significantly to food security, and the recent agriculture census indicates an increased fishing effort by many rural communities.*

Thus, three pilot projects on Pele Island, South Efate, and South Santo introduced community land-use plans so that coastal erosion could be minimized and agricultural gains maximized.

4.2 Enhancing institutional capacity

About half (52 %) of respondents indicated that adaptation efforts in our five LDCF projects prioritized not only on infrastructure but also capacity building. In Bangladesh, the government provided free training sessions for local level administrators in disaster management and also facilitated input from civil society and community members in the formulation of state and national policies and regulations. R144 remarked in 2015 that "to be sure these efforts are not a panacea, and so far only about 50 people have been trained, but the idea is that by 'training the trainers' that number could reach into the hundreds or thousands in a few years."

In Bhutan, the project funded the training of geologists and employment for civil engineering work. It sponsored the creation of community based disaster management committees, whose job it was to highlight hazards and form district disaster management teams at village levels. This, as R130 remarked in 2015, "ensured that disaster relief efforts could be undertaken in a decentralized and autonomous manner, without the need for central coordination."

In Cambodia, their LDCF project promulgated community development plans based on long-term climate forecasts and scenarios, budgeting for water resources investments. The project also empowered commune councils, farmer water user communities, and planning and budget committees to become more active in adaptation project planning. These groups, R138 mentioned in 2015, "have certainly contributed to the overall state of knowledge within the country about climate risks and attempts to manage them – feedback that would have been missing without the project."

In the Maldives, institutional capacity was strengthened through the training of government officials in risk analysis, hazard mitigation, and land use planning. Part of this component involved participating with local island leaders—some who according to R140 in 2015 "had never heard of climate change before"—to share knowledge and learn about local efforts at deploying adaptation measures.

In Vanuatu, the government sponsored consultations with stakeholders to learn about options to bolster sector-level resilience measures which attempt to improve adaptive capacity beyond merely coastal and marine resources to encompass agriculture, tourism, and forestry. The idea here, in the words of R146 in 2015, was to promote "an integrated, cross-sectoral response to climate change."

4.3 Improving community assets

About 40 % of respondents articulated that each LDCF adaptation project enhanced community and social resilience in some dimension. In many parts of the coastal forests of Bangladesh, before the project began annual per capita income was less than US$130, one-third the national average, rendering people completely dependent on wetlands and coastal forests to meet their subsistence needs (Matthew 2007). Three quarters of the population lived in rural areas and depended on subsistence agriculture, which contributed to about one-quarter of national GDP. To counter this incentive to damage forests for economic survival, the LDCF project facilitated occupational training and livelihood diversification among rural communities. One innovative element of this component was its focus on the "Triple F″ model of "Forestry, Fish, and Fruit." The "FFF" model attempted to integrate community livelihood efforts with adaptation by enabling aquaculture and food production within reforested and afforested plantations. Our interview respondents (R110, R112, and R118) estimated that as many as 15,000 households across four districts were generating income from the FFF model as of early 2015.

In Bhutan, a community awareness subcomponent was implemented in Punakha, Wangdi and Bumthang. Officials created a zoning map to mark several safe evacuation routes, and erected emergency operation centers at district administration offices. Communities were trained in their response to calamities and emergency situations using mobile phones and radio broadcasts.

In Cambodia, funds from the project were transferred to support a sample of agricultural adaptation projects selected by village planning committees. Cambodia is largely an agrarian society where some three-quarters of its 13.4 million people were rice farmers. Most village supported projects therefore prompted farmers to plant new varieties of rice which could withstand harsher temperatures and increased crop stress. As R88 articulated in 2010, "Piloting across fifteen rice farms indicates that the seeds really are more resistant to harsh climate than normal seeds, and they have higher yields as well."

In the Maldives, planners emphasized increasing awareness of climate change in the outer atolls. As R55 noted in 2010, the program dispatched "training teams" to remote islands to "create awareness among the community so that they can take stock of existing vulnerabilities and soft adaptation measures."

In Vanuatu, R99 noted in 2010 that a "standard climate kit" with key messages about climate change was designed and distributed to communities around Port Vila and is in the process of being scaled up (under a second project currently ongoing) for distribution in rural areas, where they will be given to tribal chiefs.

5 Stated challenges facing LDCF finance

Though these effects are notable, our interview data suggests that the LDCF also faces challenges: (1) insufficient and uncertain funding, (2) a convoluted management structure, (3) the complexity of adaptation projects within the context of least developed countries, and (4) an inability to fully manage climate-related risks.

5.1 Insufficient and uncertain funding

About 45 % of respondents mentioned this challenge. Because the LDCF is supposed to prioritize what R55 called "equitable access" for all participating countries, individual projects have a "ceiling" on the amount they support. For instance, from 2001 to 2006 the cap on LDCF projects was $3.5 million, in 2008 it was raised to $6 million, in 2010 it was increased to $8 million, and in 2014 it was $20 million (though most recent projects averaged below the cap at between $6 and $7 million). Although the LDCF had a mandate to finance the full additional cost of adaptation, without a requirement for matching co-financing, in practice the ceiling inadvertently required hosting governments to cosponsor projects, or find other institutions to match contributions. Moreover, because the LDCF was voluntary, it was only replenished when donor countries decided to be generous, making it difficult to accurately predict the amount of resources available to countries over long timeframes (GEF 2009a).

Furthermore, the LDCF was clearly insufficient to ensure the implementation of all needed adaptation projects. As noted earlier, the fund has leveraged more than $900 million. This created what R78 called "huge gap" between funding amounts and needs, with an estimated $10 to $100 *billion* in annual funding needed to prepare all developing countries for climate change (Flam and Skjaerseth 2009). (We say "estimated" because such calculations are always tentative). Similarly, an assessment from the Potsdam Institute for Climate Impact Research, European Environment Agency, and other institutions calculated that at least $70 to $100 billion of investment will be needed per year for every year from 2010 to 2050 if adaptation needs are to be met (Füssel et al. 2012). To be fair, not all of this would need directed at LDCs—of the five global adaptation funds mentioned in Table 1 above, the LDCF is one of the smallest. But there is an argument to be made, based on energy justice (Sovacool and Dworkin 2014) or climate justice (Arnold 2011), that LDCs may be even more deserving of funds (due to their enhanced vulnerability, and lack of culpability in terms of minimal greenhouse gas emissions) than other classes of countries.

5.2 Convoluted structure

Separate from its amount of funding, about one-third of our respondents challenged the LDCF for having a convoluted management structure resulting in unnecessary delays for projects. Part of the reason is that the LDCF was administratively and legally "outside of the GEF Trust Fund" (Grasso 2010). This meant the LDCF had to create an entirely separate management structure. During the fourteenth session of the Conference of the Parties (COP14) in Poznan, Poland, in 2008, some least developed countries "expressed their frustration" at this structure, at the speed with which projects were allocated funding, and at the "long and complicated" nature of implementing NAPAs (UNDP 2009). A small sample of our respondents (10) were highly critical of the LDCF, with R14 calling the administrative structure of the LDCF "a headache," R22 labeling it a "ridiculously and needlessly complex," and R55 stating that it was "a nightmare."

5.3 The complexity of adaptation

About one-third of respondents mentioned this particular challenge. Though the LDCF has made progress implementing a range of adaptation projects, the vast needs of least developed countries have nonetheless proven beyond the means of the technical and institutional capacity

of many implementing stakeholders. In Bhutan, for instance, draining glacial lakes proceeded much slower than expected (Nayar 2009). Heavy rainfall washed away several key bridges to project sites, the Bhutanese government was unable to purchase high-resolution satellite imagery, and project managers could only afford to pay a few hundred local workers who had to use shovels, spades, and a few jackhammers and chisels; no automated or heavy machinery was available (GEF 2009b). As a result work progressed, in the words R60 in 2010, "at a snail's pace, much slower than we had hoped."

In the Maldives, respondents noted that the "heterogeneity" or "specificity" of adaptation measures has led to complications. As R30 stated in 2010:

> *The unique geography of Maldivian islands is a challenge when it comes to infrastructure, even softer adaptive measures. The needs of an elongated island on an outer atoll will differ greatly from those of a roundish island on an inner atoll. Patterns of sedimentation, the type and longevity of coral reefs, the socio-demographic composition of settled communities will all require different, site-specific options. There is likely not a "one size fits all" solution.*

In Bangladesh, despite the government's training efforts, capacity building efforts proceeded according to R55 in 2010 "weakly" and "slowly," and in Cambodia and Vanuatu the average government officer still possessed, according to R134 in 2015, "minimal knowledge about climate change and therefore may not see the necessity of adaptation efforts."

5.4 Inability to eliminate risks

About one-quarter of respondents mentioned this challenge. The starting point of the LDCF is the formulation and implementation of country specific NAPAs, which represent a critical first step in implementing adaptation projects. These NAPAs, while useful tools, are ultimately only guideposts for how to prioritize adaptation investments; they do not directly provide the financing for those plans. Moreover, such NAPAs are of an admittedly mixed quality—some need to be improved before investments can be prioritized (OECD 2008). As R12 stated in 2010, "the success of the NAPA process will largely be determined by how well it paves the way for scaled up investments in climate-resilient development in accordance with integrated, long term plans." In other words, the presence of such plans is no guarantee that their recommended measures will be implemented. It's hard to fault such countries for this shortcoming (of having a plan but not following it) since adaptation planning in the United States, Australia, and United Kingdom faces similar short-comings (Preston et al. 2011).

Even if countries were to fully implement the priorities formulated in their own NAPAs, however, there is no guarantee that they would sufficiently increase resilience or reduce climate-related risks. For instance, if sea levels rise under more extreme scenarios, practically no amount of adaptation or investment in resilience will suffice for countries such as Bangladesh, the Maldives, or Vanuatu (Muis et al. 2016; DeConto and Pollard 2016). As R30 explained in 2010:

> *The challenge Bangladesh now faces is to cope with changes in climate already happening every year. We are strengthening coastal embankments, yes, but the intensity of erosion and frequency of storms are also increasing and I feel like we are often in a race against time where time is running out. We have developed saline-tolerant rice varieties but the concentration of salinity is going up. We can't keep on producing crops*

when land is flooded and water salty; it's practically not possible at the moment. Adaptation has its limits.

If the situation worsens, or if adaptation investments are not able to keep pace with vulnerabilities and risks, low-lying countries, and especially small island developing states, may have to switch retreat measures such as forcibly relocating communities to higher ground. Similarly, in the Maldives and Vanuatu, a sea level rise of one meter would put the country, as R40 explained in 2010, "completely under water." In the Maldives, most islands are less than 1 m high, meaning even small rises in sea level could subject the country to "regular tidal inundations" (Republic of Maldives 2007). In Vanuatu, R140 remarked in 2015 that "under the more severe projections of sea level rise, we may not be able to save the country no matter what we do."

6 Conclusion and policy implications

This paper has documented the effects and challenges facing a sample of five projects financed from the Least Developed Countries Fund (LDCF) being implemented in the Asia Pacific. As such, it represents slightly more than 2 % of the total number of LDCF projects. While we hold that the results and findings from the case studies remain valid and interesting lessons can be learnt from them, they constitute such a small proportion of the total number of LDCF projects that care must be taken when generalizing results. Notwithstanding this limitation, we argue that this LDCF study brings to light two salient conclusions related to climate policy and adaptation practice.

First, our LDCF analysis underscores the necessity of viewing adaptation to climate change as a multidimensional process. Bangladesh is not only building dykes and mangrove plantations, it is incentivizing agriculture and aquaculture to improve community income and training local officials. Bhutan is not only altering the physical shape of glacial lakes and rivers, building shelters, and creating an early warning system, but educating public and private leaders about emergency preparedness and climate risks. Cambodia is not only experimenting with crops and rehabilitating canals and ponds, but educating provincial officials and empowering local villagers to decide on infrastructure investments. Maldivian planners are not only thickening coastal vegetation and nourishing coral reefs, but decentralizing planning and disbursing funds directly to local communities so that they can decide what is best for them. Vanuatu planners are hardening coastal infrastructure, soliciting feedback from stakeholders and civil society, and enhancing the informational awareness of indigenous peoples in rural areas. Their efforts remind us that adaptation may work best not by tinkering with technology alone, but seamlessly strengthening three types of adaptation—infrastructural, organizational, and social—to bolster ecosystems, communities, and human organizations (Klein 2011).

Second, lingering challenges continue to blunt the efficacy of the LDCF. A lack of ability among poorer countries to leverage climate investments has been a concern in the UNFCCC negotiations on how to raise and prioritize climate financing between mitigation and adaption and between private and public finance (Fridahl et al. 2014). More specifically, the LDCF faces obstacles such as insufficient funding and a convoluted structure dependent on multiple partners and financing flows at varying scales. As such, the adaptation implementation efforts examined have had to confront continual tradeoffs, and prompted only incremental change rather than more radical or systematic transformations.

In other words, efforts across our five cases were highly context specific and none of them proceeded effortlessly. Bhutan has seen disaster preparedness work proceed only at a "snail's pace." Interventions in the Maldives have focused primarily on urban areas such as Male or places with tourist infrastructure; rural communities and the outer lying islands have been largely unprotected. The capacity building of national and local planners in Bangladesh, Cambodia and Vanuatu has been minimal. Consequently, our sample of LDCF projects seemingly built particular dimensions of resilience in a fragmented, ad hoc way that did not necessarily achieve integration, efficacy, or the mainstreaming of adaptation. Our finding may motivate climate funders to truly redesign or scale up their financing efforts for least developed countries.

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Appendix

Table 4 Summary of Semi-Structured Research Interviews

Date	Institution	Location	Number of interviews
May 2010	Rockefeller Foundation	Bangkok, Thailand	2
	World Resources Institute	Washington, DC, United States	2
	United Nations Development Program Regional Center	Bangkok, Thailand	1
June 2010	United Nations Development Program Bhutan	Thimpu, Bhutan	3
	Bhutan National Environment Commission	Thimpu, Bhutan	1
	Disaster Management Division, Bhutan Ministry of Home and Cultural Affairs	Thimpu, Bhutan	2
	Bhutan Gross National Happiness Commission	Thimpu, Bhutan	1
	World Wildlife Fund Bhutan	Thimpu, Bhutan	1
	Bhutan Department of Geology and Mines	Thimpu, Bhutan	2
	Punakha Dzongkhag Administration (Bhutan)	Punakha, Bhutan	1
	Bumthang Dzongkhag Administration (Bhutan)	Chamkhar, Bhutan	1
	Bhutan Department of Energy	Thimpu, Bhutan	1
	Bhutan Department of Agriculture	Thimpu, Bhutan	1
	Punakha Dzong Community (Bhutan)	Punakha, Bhutan	1

Table 4 (continued)

Date	Institution	Location	Number of interviews
	Punakha Valley Township (Bhutan)	Punakha, Bhutan	2
	Wangdue Valley Community (Bhutan)	Wangdue Phodrang, Bhutan	2
	Chamkhar Valley Community (Bhutan)	Bumthang, Bhutan	1
	Bangladesh Forestry Department	Dhaka, Bangladesh	3
	Bangladesh Forestry Department	Noakhali, Bangladesh	1
	Bangladesh Forestry Department	Cox's Bazaar, Bangladesh	1
	Bangladesh Forest Research Institute	Chittagong, Bangladesh	2
	Bangladesh Ministry of Environment and Forests	Dhaka, Bangladesh	1
	Bangladesh Center for Advanced Studies	Dhaka, Bangladesh	1
	United Nations Development Program Bangladesh	Dhaka, Bangladesh	1
	United Nations Development Program Bangladesh	Cox's Bazaar, Bangladesh	1
	Hatiya Island Community (Bangladesh)	Noakhali, Bangladesh	1
	Anwara Upazila Community (Bangladesh)	Raipur Union, Bangladesh	1
	Cox's Bazaar Community (Bangladesh)	Cox's Bazaar, Bangladesh	1
	Moheshkhali Village Community (Bangladesh)	Cox's Bazaar, Bangladesh	1
July 2010	United Nations Development Program Maldives	Malé, Maldives	6
	Maldives Climate Change and Energy Department	Malé, Maldives	4
	Maldives Ministry of Housing, Transport, and Environment	Malé, Maldives	3
	Maldives Meteorological Service	Hulhulé, Maldives	4
	Hulhulé Island Community (Maldives)	Hulhulé, Maldives	3
	Malé Harbor Community (Maldives)	Malé, Maldives	3
	Gan Island Community (Maldives)	Gan, Maldives	2
	Villingili Island Community (Maldives)	Villingili, Maldives	2
	Maradhoo Island Community (Maldives)	Maradhoo, Maldives	3
	Hulhumalé Island Community (Maldives)	Hulhumalé, Maldives	3
August 2010	Preah Vihear Department of Agriculture (Cambodia)	Tbeng Meanchey, Preah Vihear Province, Cambodia	1
	United Nations Development Program Cambodia	Tbeng Meanchey, Preah Vihear Province, Cambodia	1
	Krao Bao Village (Cambodia)	Kulen Etbong Commune, Kulen District, Preah Vihear Province, Cambodia	4
	Preah Klaing Commune (Cambodia)	Tbeng Meanchey District, Preah Vihear Province, Cambodia	4
	Sethakich Village (Cambodia)	Chhean Mok Commune, Tbeng Meanchey District. Preah Vihear Province	4
	Thanal Bek Village (Cambodia)	Thmey Commune, Tbeng Meanchey District, Preah Vihear Province, Cambodia	3

Table 4 (continued)

Date	Institution	Location	Number of interviews
	Development and Partnership in Action Cambodia	Kampong Thom, Cambodia	1
	Chambak Village (Cambodia)	Taing Krasang Commune, Santuk District, Kampong Thom Province, Cambodia	6
	Cambodia Ministry of Environment	Phnom Penh, Cambodia	2
	Cambodia General Directorate of Agriculture	Phnom Penh, Cambodia	1
	United Nations Development Program Cambodia	Phnom Penh, Cambodia	2
	Cambodian Centre for Study and Development in Agriculture	Phnom Penh, Cambodia	1
October, 2010	Global Environment Facility	Delhi, India	1
	Global Environment Facility	Washington, DC, United States	2
	Pact	Delhi, India	2
	Stockholm Environment Institute	Delhi, India	1
November 2010	National Advisory Committee on Climate Change	Port Vila, Vanuatu	5
	Ministry of Lands and Natural Resources	Port Vila, Vanuatu	3
	Ministry of Education and Training	Port Vila, Vanuatu	1
	AusAid	Port Vila, Vanuatu	1
	United States Agency for International Development	Port Vila, Vanuatu	1
	CARE International	Port Vila, Vanuatu	3
January 2015	Bhutan National Environment Commission	Thimpu, Bhutan	2
	Disaster Management Division, Bhutan Ministry of Home and Cultural Affairs	Thimpu, Bhutan	1
	Bhutan Department of Geology and Mines	Thimpu, Bhutan	1
	Bangladesh Forestry Department	Dhaka, Bangladesh	2
	Bangladesh Forest Research Institute	Chittagong, Bangladesh	1
	Bangladesh Ministry of Environment	Dhaka, Bangladesh	2
February 2015	Maldives Climate Change and Energy Department	Malé, Maldives	2
	Maldives Ministry of Housing, Transport, and Environment	Malé, Maldives	2
	Maldives Meteorological Service	Hulhulé, Maldives	1
	Department of Agriculture	Phnom Penh, Cambodia	1
	Climate Change Department, Ministry of Environment	Phnom Penh, Cambodia	3
	National Climate Change Committee	Phnom Penh, Cambodia	1
	Ministry of Climate Change and Natural Disasters	Port Vila, Vanuatu	4
Total			146

References

Afful-Koomson T (2014) The green climate Fund in Africa: what should be different? Clim Dev 7(4):367–379

Alber J, Nielsen HS, Richardson B (2013) *A poetics of unnatural narrative*. Ohio State University Press, Columbus

Arnold DG (ed) (2011) The ethics of global climate change. Cambridge University Press, Cambridge, U.K.

Bachofen C, Sundstrom R, Iqbal FY, Suarez P (2015) Participation, learning and innovation in adaptation to climate change. Clim Dev 7(2):192–195

Biagini B, Miller A (2013) Engaging the private sector in adaptation to climate change in developing countries: importance, status, and challenges. Clim Dev 5(3):242–252

Biagini B, Kuhl L, Gallagher KS, Ortiz C (2014a) Technology transfer for adaptation. Nat Clim Chang 4:828–834

Biagini B et al (2014b) A typology of adaptation actions: a global look at climate adaptation actions financed through the global environment facility. Glob Environ Chang 25(2014):97–108

Czarniawska B (2004) Introducing qualitative methods: narratives in social science research. Sage, London

DeConto, Robert M, David Pollard (2016) Contribution of Antarctica to past and future sea-level rise, Nature 531 (March 31), pp. 591–597.

Flam KH, Skjaerseth JB (2009) Does adequate financing exist for adaptation in developing countries? Clim Pol 9:109–114

Fridahl M, Linnér B-O (2016) Perspectives on the green climate fund: possible compromises on capitalization and balanced allocation. Clim Dev 8(2):105–109

Fridahl M, Upadhayay P, Linnér B-O (2014) Supporting nationally appropriate mitigation actions through the green climate fund: governance capacities and challenges. Carbon Clim Law Rev 4:257–269

Füssel, Hans-Martin, Stephane Hallegatte, Michael Reder (2012) International adaptation funding. O. Edenhofer et al. (eds.), Climate change, justice and sustainability: linking climate and development policy (Springer), pp. 311–330

Global Environment Facility (GEF) (2009a) *Accessing resources under the least developed countries fund*. GEF, Washington

Global Environment Facility (GEF) (2012) LDCF resources now amount to more than half a billion dollars (US $537 Million), press release. GEF, Washington

Global Environment Facility (GEF) (2015) Progress report on the least developed countries fund and the special climate change fund (may 8, 2015), GEF/LDCF.SCCF.18/03. GEF, Washington, DC

Global Environment Facility (GEF) (2009b) Strategy on adaptation to climate change for the least developed countries fund (LDCF) and the special climate change fund (SCCF). GEF, Washington

Grasso M (2010) Justice in funding adaptation under the international climate change regime. Springer, London

Hatavara M, Hyden L-C, Hyvarinen M (2013) *The traveling concepts of narrative*. John Benjamins Publishing Company, Amsterdam

Klein RJT (2011) Adaptation to climate change: more than technology. In: Christiansen L, Olhoff A, Trærup S (eds) Technologies for adaptation: perspectives and practical experiences. Technology Transfer Perspectives. UNEP Risø Centre on Energy, Climate Change and Sustainable Development, Roskilde, pp. 19–25

Klein RJT, Möhner A (2011) The political dimension of vulnerability: implications for the green climate fund. IDS Bull 42(3):15–22

Matthew RA (2007) Climate change and human security. In: DiMento JFC, Doughman P (eds) *Climate change: what it means for us, our children, and our grandchildren*. MIT Press, Cambridge, pp. 161–180

Muis S et al (2016) A global reanalysis of storm surges and extreme sea levels. Nat Commun 7(11969). doi:10.1038/ncomms11969

Nayar A (2009) When the ice melts. Nature 461(October 22):1042–1046

OECD (2008) Economic aspects of adaptation to climate change. OECD, Paris

Osman EB, Downing TE (2007) Lessons learned in preparing national adaptation programmes of action (NAPAs) in Eastern and Southern Africa. European capacity building initiative. Available at http://www.eurocapacity.org/downloads/ecbi_NAPA_PA_Project_2007.pdf

Preston BL, Westaway RM, Yuen EJ (2011) Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. Mitig Adapt Strateg Glob Chang 16:407–438

Rahman SM, Ahmad MM (2014) Climate finance in the greater Mekong Subregion (GMS). Dev Pract 24(8): 960–974

Republic of Maldives (2007) *National adaptation program of action: republic of Maldives*. Ministry of Environment, Energy, and Water, Malé

Sovacool BK, Dworkin MH (2014) Global energy justice: problems, principles, and practices. Cambridge University Press, Cambridge

Sovacool BK, D'Agostino AL, Meenawat H, Rawlani A (April, 2012a) Expert views of climate change adaptation in least developed Asia. J Environ Manag 97(30):78–88

Sovacool BK, D'Agostino A, Rawlani A, Meenawat H (August, 2012b) Improving climate change adaptation in least developed Asia. Environ Sci Pol 21(8):112–125

Strauss AL (1990) *Qualitative analysis for social scientists*. Cambridge University Press, Cambridge

UNDP (2009) *Evaluation of UNDP work with least developed countries fund and special climate change fund resources*. UNDP Evaluation Office, New York

UNFCCC 2014a. Synthesis report on the progress made in the implementation of the remaining elements of the least developed countries work programme, subsidiary body for implementation forty-first session, lima, 1–8 December 2014

UNFCCC 2014b. Report of the global environment facility to the conference of the parties, Conference of the Parties, Twentieth session, Lima, 1–12 December 2014